

REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-20 are active in this application, Claim 1 having been amended, and Claims 5-16 and 18-20 having previously been withdrawn. Support for amended Claim 1 can be found, for example, in the original claims, drawings, and specification as originally filed.¹ Applicants respectfully submit that no new matter is added.

In the outstanding Official Action, Claim 1 was rejected under 35 U.S.C. § 102(b) as anticipated by Sportouch et al. (Thermoelectric Properties of Half-Heusler Phases: $\text{ErNi}_1\text{xCu}_x\text{Sb}$, $\text{YNi}_{1-x}\text{Cu}_x\text{Sb}$ and $\text{Zr}_x\text{Hf}_y\text{Ti}_z\text{NiSn}$, 18th International Conference on Thermoelectrics, 1999, pgs 344-347; hereinafter “Sportouch”); Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl et al. (Efficient dopants for ZrNiSn based thermoelectric materials, *J. Phys.: Condens. Matter*, 11, 1999, pgs 1697-1709; hereinafter “Hohl”); Claim 17 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Bell (U.S. Patent No. 6,700,052); Claim 1 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen et al. (Synthesis and Sintering of ZrNiSn Thermoelectric Compounds, 21st International Conference on Thermoelectrics, August 25-29, 2002, pgs 166-169, hereinafter “Shen”); Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, further in view of Hohl; Claim 17 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, further in view of Bell; and Claims 1-4 and 17 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1-18 of copending Application No. 11/088,245.

¹ See page 25, line 10 to page 26, line 24 of the specification.

Initially, Applicants note that Tables 1-7 in the specification have been amended to correct typographical errors. Specifically, the heading “Dimensionless performance index ZT” in Tables 1-7 has been amended to recite “Dimensionless figure-of-merit ZT.” Further, in the specification, the abbreviation “TZ” has been corrected to recite “ZT.”

Further, Applicants note that a terminal disclaimer was filed on May 24, 2007 in response to the double patenting rejection, and that the terminal disclaimer is still pending Office Approval.

In response the rejection of Claim 1 under 35 U.S.C. § 102(b) as anticipated by Sportouch and 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, Applicants respectfully submit that amended independent Claim 1 recites novel features clearly not taught nor rendered obvious by the applied references.

Amended independent Claim 1 is directed to a:

...thermoelectric material which is sintered body and represented by composition formula (1) and comprises as a major phase an MgAgAs crystal structure, the sintered body being obtained by manufacturing an alloy containing predetermined elements, pulverizing the alloy to obtain an alloy powder, and monolithic molding the alloy powder by sintering, hot press or SPS method, wherein the composition formula (1) is $(\text{Ti}_{a1}\text{Zr}_{b1}\text{Hf}_{c1})_x\text{Ni}_y\text{Sn}_{100-x-y}$, and

a_1, b_1, c_1, x and y satisfy the conditions of: $0 < a_1 < 1$, $0 < b_1 < 1$, $0 < c_1 < 1$, $a_1 + b_1 + c_1 = 1$, $30 \leq x \leq 35$ and $30 \leq y \leq 35$.

An advantageous feature of Applicants’ Claim 1 is that because a pulverized alloy powder is sintered by a hot press or SPS method, the sintered body has a fine grain size and uniform composition. Thus, the oxygen concentration included in the sintered body as impurities is minimized. Consequently, the thermoelectric characteristics are improved.

Page 6 of the outstanding Office Action acknowledges that Sportouch does not teach or suggest a sintered body. In an attempt to cure this deficiency of Sportouch, the

outstanding Office Action cites Shen. However, Shen fails to teach or suggest “the sintered body being obtained by manufacturing an alloy containing predetermined elements, pulverizing the alloy to obtain an alloy powder, and monolithic molding the alloy powder by sintering, hot press or SPS method,” as recited in Applicants’ amended independent Claim 1.

In Shen, a raw material metallic powder is only processed by a solid state reaction and is not melted. Thus, *an alloy is not obtained*. Consequently, in order to obtain a sintered body having a fine grain size, the raw material metallic powder should also have a fine grain size. Naturally, if the particle diameter of the raw material metallic powder becomes small, the specific surface area of the metallic powder becomes large, and the oxygen concentration for the unit weight becomes high.

In other words, Shen obtains the sintered body from a raw material including a large amount of oxygen. Thus, the sintered body of Shen includes a large amount of oxygen as impurities. The thermoelectric characteristics of Shen are adversely affected due to the large amount of oxygen.

In contrast, the thermoelectric material recited in Applicants’ Claim 1 has improved thermoelectric characteristics compared to Shen because the amount of oxygen included in the sintered body is small.

In Applicants’ invention, a metallic lump having a small specific surface area is prepared as a raw material, and an alloy is obtained by melting the raw material. A powder obtained by pulverizing the alloy is sintered. Thus, the oxygen concentration included in the sintered body as impurities is minimized. The thermoelectric characteristics are improved, because the oxygen concentration is reduced. The alloy is obtained by a liquid state reaction, and the liquid state reaction generally has a higher reactivity than a solid state reaction. Thus, the uniformity of the obtained materials is improved, which in turn improves the thermoelectric characteristics of the material.

Accordingly, Applicants respectfully submit that independent Claim 1 (and all claims depending thereon) patentably distinguishes over Shen and Sportouch.

Accordingly, Applicants respectfully request the rejections of Claim 1 under 35 U.S.C. §§ 102 and 103 be withdrawn.

In response to the rejection of Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl, Applicants respectfully submit that Hohl fails to cure any of the above-noted deficiencies of Shen and Sportouch, as Hohl merely describes efficient dopants for ZrNiSn-based thermoelectric materials and does not describe a sintered body. Further, Claims 2-4 are dependent on independent Claim 1 and are believed to be patentable for at least the reasons discussed above.

Accordingly, Applicants respectfully request the rejection of Claims 2-4 under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl be withdrawn.

In response to the rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Bell, Applicants respectfully submit that Bell fails to cure any of the above-noted deficiencies of Shen and Sportouch, as Bell merely describes a flexible thermoelectric circuit and does not describe anything about a sintered body. Further, Claim 17 is dependent on Claim 1 and is thus believed to be patentable for at least the reasons discussed above.

Accordingly, Applicants respectfully request the rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view Shen and further in view of Bell be withdrawn.

Consequently, in view of the present amendment, and in light of the above discussion, the pending claims as presented herewith are believed to be in condition for formal allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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